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Abstract

THE EFFECTS OF NEUTRON IRRADIATION ON VARIOUS FUELS USED IN GAS-GRAPHITE REACTOR SYSTEMS

by Mmes J. LANIESSE - Ingénieur au SRMA-DIR
J. LEHMANN - Chef de la Section SRMA-SEAU
MM. C. ALLAIN - Ingénieur au SRMA-SEAU
H. AUBERT - Ingénieur au SRMA-DIR
M. ENGLANDER - Chef du Service RMA

(Commissariat à l'Energie Atomique, France)

The behaviour of natural uranium based fuels in form of rods and tubes has been examined after irradiation in several French reactors.

Two categories of uranium alloys have thus been studied : on one hand alloys contaming from 0, 5 to 3 p. 100 by weight of molybdenum, and on the other hand alloys obtained by addition to nuclear purity uranium, of less than 1500 p. p. m. of metallic elements such as iron, aluminium, chromiumand silicon.

The tests have been carried out with two types of elements : one canned with a magnesium alloy and cooled by carbon dioxide under pressure (in G 2, G 3), the other canned with aluminium and cooled by heavy water (in EL 3). Each of these elements had the same outside form as the usual elements in these reactors, but the enrichment and thickness of the fuel were adapted in order to meet different irradiation conditions.

The post-irradiation examinations described, thereafter involved techniques of metrology, of radiography, of density measurements before and after isochronic annealings, as well as macrographies or optical and electronic micrographies.

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The experimental results thus obtained reflect the changes in the internal and external structures of the full-size fuel elements ; they are discussed in terms of the combined effects of pressure, temperature and burn-up on the morphological state, on the isotropy and on the mechanical characteristics of the initial polycrystalline aggregate.

An analysis of the results makes it possible to deduce the various advantages of un-enriched metallic fuels designed to operate with a hot-point of around 600°C in reactors of the gas-graphite type, and for a length of time corresponding to an output of 4500 MW day/metri ton.